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CHARACTERISTICS OF COMMON RODENTICIDES

Research and experience, over the years, have thus far failed to produce a rat poison that is universally effective, one that meets all requirements under all conditions. A number are quite useful; most have one shortcoming or another. A rodent-control investigator or operator finds it necessary to be familiar with the characteristics of all useful poisons in order to select the one - or series - that best fits each particular circumstance. Such factors as toxicity, dosage levels, and relative effectiveness are obviously important. Less often considered, but of equal importance, are degrees of acceptance and reacceptance and the development of tolerances. Odor and taste may be considerations in some instances. Solubility of the material has a definite bearing on bait mixing techniques. Safety precautions are an essential part of any procedure, requiring attention to hazards to the user as well as to humans and animals that might come into contact with exposed baits. The appended table is an attempt to classify the common rodenticides so that they can easily be compared for these purposes.

It is obvious that full justice cannot be given to some of the categories in the abbreviated space allowed in the tabulation; many do not lend themselves readily to one word descriptions. Although an effort was made to qualify noteworthy variations with footnotes, minute and technical differences had to be sacrificed for the sake of brevity. For example, the degree of hazard existing when a poison is used is purely empirical unless it can be assumed that normal precautions will be followed. The term "antidote" actually means the counteracting of an effect, whereas most so-called antidotes of economic poisons are in reality first-aid treatments, followed by palliatives and sedatives. The statements listed in that column are simply abbreviated descriptions and are not intended as complete directions. The differences between solutions and suspensions and between different types of oils have led to a simple listing of whichever material serves a useful purpose in bait mixing; even then some qualifications are necessary and occasional variations in technique have to be ignored.

Not all animals react alike. Even within the same species some individuals are considerably more resistant to toxic effects than the average. Some effects vary with seasons, age classes, diet, and even with sexes. Dosage levels are usually calculated to include the bulk of the above-average resistant animals. It is essential to understand that no value accrues from increasing those levels. Such practice is doubly objectionable, for acceptance is usually decreased while the hazard to other larger animals is greatly increased. All that is accomplished is doubling the cost of the bait. Continued re-use of the same poison in the same location, except as noted below, generally results in a decline in acceptance, bait shyness, and poor control. Poisons highly effective in one place are sometimes less effective in adjacent properties. A thorough knowledge of the materials available will assist in overcoming these problems.

SOME CHARACTERISTICS OF THE COMMON RODENTICIDES

POISONS	LETHAL DOSE (MG/KG)	PERCENT USED IN BAIT	DEGREE OF EFFECTIVENESS	DEGREE OF ACCEPTANCE	DEGREE OF REACCEPTANCE	CUMULATION (FATAL)	TOLERANCE DEVELOPED	ODOR	TASTE	CHEMICAL DETERIORATION IN BAITS	CARRIER USED IN BAIT MIXING			ACTION (CAUSE OF DEATH)	RELATION TO HUMANS AND TO OTHER ANIMALS			
											USE DRY	WATER BASE	OIL BASE		SECONDARY POISONING	SKIN ABSORPTION	DEGREE OF HAZARD IN USE	ANTIDOTES[11]
• ANTU (ALPHANAPTHYLTHIOUREA)	8[1]	1.5	GOOD[1]	GOOD	POOR	NO	YES	SLIGHT	MODERATE	SLIGHT	YES	NO	NO	■ PLEURAL EFFUSION (OVER-PRODUCTION OF FLUID IN THE LUNGS)	NO	NO	MODERATE	NONE
•• ARSENIC TRIOXIDE	100[2]	3	FAIR	FAIR	FAIR	NO	YES	NONE	MODERATE[6]	NONE	NO	YES[7]	NO	■ KIDNEY DESTRUCTION; GASTRO-ENTERITIS; CENTRAL NERVOUS SYSTEM AFFECTED	NO	NO[10]	MODERATE	MILK OF MAGNESIA, MILK, AND WATER; OXIDE OF IRON
•• ARSENIOUS OXIDE (MICRONIZED)	25	1.5	GOOD	FAIR	FAIR	NO	YES	NONE	MODERATE[6]	NONE	NO	YES[7]	NO	■ DO	NO	NO[10]	MODERATE	DO
• BARIUM CARBONATE	750+	20	POOR	POOR	POOR	NO	NO	NONE	SLIGHT[6]	NONE	NO	YES	NO	■ INTESTINAL SPASMS; DIGITALIS-LIKE ACTION; PARALYSIS OF CENTRAL NERVOUS SYSTEM	NO	NO	SLIGHT	MAGNESIUM SULFATE
•• PHOSPHORUS, YELLOW	1.7[3]	.05	GOOD	GOOD	FAIR	NO	NO	STRONG	STRONG	STRONG	NO	NO	YES	■■ HEART PARALYSIS; GASTRO-INTESTINAL AND LIVER DAMAGE	NO	NO	MODERATE	COPPER SULFATE BEFORE EMETIC; CATHARTIC AND WATER; AVOID FATS AND OILS (AS MILK)
• RED SQUILL (FORTIFIED)	500[4]	10	FAIR	FAIR	POOR	NO	NO	MODERATE	STRONG[6]	MODERATE	YES	YES	YES	■ DIGITALIS-LIKE ACTION; HEART PARALYSIS	NO	NO	SLIGHT	ACTS AS OWN EMETIC TO ANIMALS CAPABLE OF VOMITING
••• SODIUM FLUOROACETATE (COMPOUND 1080)	5=NORWAY 2=ROOF 10=MICE	1/2 OZ./BAL. 1 OZ./28 LBS.	GOOD	GOOD	GOOD	NO	NO	NONE	SLIGHT	SLIGHT	NO	YES[7]	NO	■■ PARALYSIS OF HEART AND CENTRAL NERVOUS SYSTEM	YES	NO[10]	EXTREME	NONE[12]
•••• STRYCHNINE (ALKALOID)	6	0.6	FAIR	FAIR	POOR	NO	YES	NONE	STRONG[6]	NONE	NO	YES	NO[8]	■■■ CONVULSIONS DUE TO SUPER-STIMULATION OF NERVOUS SYSTEM; EXHAUSTION; ASPHYXIA	NO	NO	MODERATE	NO EMETIC AFTER 10 MINUTES; CHARCOAL IN WATER AND SEDATIVE; KEEP IN DARK ROOM
•••• STRYCHNINE SULFATE	8	0.8	FAIR	FAIR	POOR	NO	YES	NONE	STRONG[6]	NONE	NO	YES	NO[8]	■■■ DO	NO	NO	MODERATE	DO
••• THALLIUM SULFATE	25	1.5 (2% IN WATER)	GOOD	GOOD	GOOD	YES	NO	NONE	SLIGHT	NONE	NO	YES[7]	NO[8]	■ GASTRO-INTESTINAL HEMORRHAGE; KIDNEY AND ENDOCRINE DAMAGE; RESPIRATORY FAILURE	YES	YES[9]	EXTREME	NONE RELIABLE; SODIUM IODIDE AND SODIUM THIOSULFATE RECOMMENDED
••• WARFARIN	1[5]	.025	GOOD	GOOD	GOOD	YES	NO	NONE	SLIGHT	NONE	YES	NO	YES	■ ANTI-COAGULANT; INTERNAL HEMORRHAGE;	YES	NO	SLIGHT	VITAMIN K, AND WHOLE BLOOD TRANSFUSIONS
••• ZINC PHOSPHIDE	40	1.0	GOOD	GOOD	GOOD	NO	NO	STRONG	STRONG	STRONG	NO	NO	YES	■■ SAME AS PHOSPHORUS	NO	NO	MODERATE	SAME AS PHOSPHORUS

• EFFECTIVE AGAINST NORWAY RATS
•• EFFECTIVE AGAINST NORWAY RATS AND ROOF RATS
••• EFFECTIVE AGAINST NORWAY RATS, ROOF RATS, AND HOUSE MICE
•••• MICE ONLY

■ SLOW ACTING
■■ FAST ACTING
■■■ VERY FAST ACTING

1. NORWAY RATS ONLY, ON FIRST EXPOSURE.
2. PARTICLE SIZES OF USP GRADES VARY; SOME COARSE POWDERS TEST AS HIGH AS 600 MG.
3. COMMERCIAL PREPARATIONS VARY FROM 1-3% IN PASTE FORM; USE AS LABEL DIRECTS.
4. MINIMUM ACCEPTABLE LEVEL; MORE TOXIC SQUILLS ARE AVAILABLE AND GIVE BETTER RESULTS.
5. SUCCESSIVE DOSES OF 1 MG. REQUIRED FOR 5-10 DAYS OR MORE (AVERAGE TOTALS: NORWAY RAT, 4 MG.; ROOF RAT, 20 MG.; HOUSE MOUSE, 10 MG.).
6. NORMALLY OBJECTIONABLE TO RATS.
7. MAY ALSO BE EXPOSED AS A WATER SOLUTION OR SUSPENSION.
8. STARCH PASTE MAY BE USED AS AN ADHESIVE.
9. CHRONIC POISONING POSSIBLE.
10. CAN BE TAKEN THROUGH CUTS OR BREAKS IN THE SKIN; ALSO DANGER OF INHALING LOOSE POWDER.
11. EMETICS ARE USED AS FIRST AID EXCEPT AS NOTED; SPEED IS ESSENTIAL; 1 TABLESPOONFUL OF SALT IN A GLASS OF WARM WATER IS USUALLY EFFECTIVE; ALWAYS CALL A PHYSICIAN IMMEDIATELY.
12. MONOACETIN OR ETHYL ALCOHOL AND ACETIC ACID RECOMMENDED

Warfarin, red squill, zinc phosphide, and ANTU are generally recommended for use by the public. They are usually available commercially and are the ones with which the untrained individual is the least likely to experience difficulties. Commercial preparations of prepared baits containing arsenic, phosphorus, and strychnine are commonly sold on the retail market; their use is best restricted to indoor protected stations where accidental poisoning hazards are minimized. Barium carbonate, once rather widely recommended, is rarely used today as it is too weak to be effective. Thallium sulfate is very dangerous and quite costly; except for some grain-treated baits used for mouse control, it is used almost exclusively by professional operators. Sodium fluoroacetate, or Compound 1080, is not available to the general public because of its extreme toxicity.

Of the first four materials mentioned above, red squill is considered among the least hazardous poisons for the untrained individual to handle. Its emetic factor offers protection to animals capable of vomiting. However, since some farm animals do not vomit, care must be taken to prevent their contact with the material. Red squill is a relatively distasteful mild poison, hence its shortcoming; so much must be incorporated into the bait that some rats object to the taste and soon learn to refuse it. ANTU, if used properly, will give good results against Norway rats, but is ineffective against roof rats and, like squill, is of no value against house mice. The strong reluctance of rats to accept a second dose as well as the marked tolerance which is developed have combined with the accidental hazards to reduce sharply the use of ANTU throughout the country. It should not be used more often than at four month intervals to obtain best results and baits containing the material should not be left in place for more than three or four days.

Zinc phosphide is not widely used, partly because it is not readily available and partly because of its high toxicity and strong odor. However, this offensive odor and unattractive color provide a safety factor. Most domestic animals will not touch baits prepared with it, but rodents seem to like the pungent odor of phosphorus compounds. Furthermore, all species of rats and mice, both domestic and native, readily accept zinc phosphide treated baits. The net result is that of the three poisons thus far mentioned, it is the most likely to produce universally satisfactory results.

A greater degree of protection to other animals, when either zinc phosphide or ANTU is used, may be obtained by incorporating tartar emetic (antimony and potasium tartrate) in the bait mixture. Approximately equal amounts with ANTU or three parts of tartar emetic to eight parts of zinc phosphide provide about the same relative degree of protection to other animals as may be expected in the case of red squill.

Warfarin, outstanding in its value to the general public, is the most recent material to be added to the list. It incorporates a radically different principle of control by poisons. An anti-coagulant, this chemical must be taken daily over a period of several days as opposed to the single dose compounds. The animals, apparently not associating the cumulative effect of internal hemorrhaging with their food supply, return to feed on warfarin treated baits again and again. Thus the problem of bait shyness is largely overcome. At the same time, hazards to other animals from single accidental feedings is greatly reduced. Since repeated feedings are required, permanent covered bait stations provide an excellent technique for exposure; relatively large supplies of bait obviate the necessity for daily care. Warfarin possesses the added advantage of being effective against all species of rats and mice.

Much of the research in rodenticides today is directed along the lines of the anti-coagulants. Used dry, in a cereal mixture such as cornmeal, or with a little oil added to prevent dusting, insects and mold may attack the finished product. Most insecticides and mold inhibitors leave objectionable tastes that cause marked reduction in acceptance, so investigations are being made of candidate materials to overcome this problem. Although warfarin is exposed in such dilute mixtures that primary poisoning by accident would require the ingestion of a huge quantity of bait, that occasionally has happened. Also, a few cases of secondary poisoning have been reported, due to pets feeding daily on dead or dying rats or mice poisoned with warfarin. Efforts should be made, then, to recover rodent carcasses whenever possible. As with other poisons, the majority of complaints of warfarin failure can be ascribed to faulty technique in exposure or failure to maintain a fresh, acceptable bait supply until the entire rat colony has been eliminated. Since some rats may not start feeding on the bait until it has been exposed for some time, or feeding may be intermittant, two or three weeks may be necessary to produce results; a mouse colony may require as long as thirty days to complete their removal.

No mention has been made of desirable bait materials, since local availability and cost are determining factors. Then too, acceptance is so widely varied, even on adjacent premises, that selection must be left to the judgment of the operator. Often only trial and error will provide the correct answer, pre-baiting being the most useful technique. Here, again, knowledge of the characteristics of the various poisons is important, as many of the bait formulations are based on the specific chemical that is used. Weather conditions should be considered before exposure. Above all, hazards to other animals must receive top attention; using materials and employing techniques best calculated to destroy rodents without attracting or being easily available to others.

The destruction of rats and mice is one of the important steps in attaining permanent rodent control. Poisons represent the most efficient and useful tools in accomplishing this end. Full advantage should be taken of the particular characteristics of each of the rodenticides, selecting those most likely to produce the desired results under the specific conditions where they are being used.